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EFFECT OF NPK FERTILIZERS ON GROWTH AND NUTRIENT CONTENTS OF MINT (*MENTHA SPICATA*) GROWTH ON SANDY SOIL

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A port experiment was conducted to evaluate the effects of three levels of each of N (20, 40 and 80 kg/ha), P (10, 20 and 40 kg/ha) and K (30, 60 and 120 kg/ha) combined on the growth and nutrient contents of mint *(Mentha spicata)* grown in sandy soil. The combination of N, P and K fertilizers significantly (P=0.05) increased the growth and N, P and K uptake by mint. The best combination was found to be N_{80} P_{40} K_{60} followed by N_{20} P_{20} K_{60} to modify the growth and NPK contents of mint. Accumulation of N, P and K by different parts of the plant followed the sequence as : stem> root> leaf. Growth and nutrient uptake of the mint have been significantly increased by the highest dose of N and medium doses of P and K fertilizers.

Keywords : Growth; *Mentha spicata;* NPK fertilizers; Nutrient uptake.

Introduction

Application of fertilizer elements in the correct ratio and rate may correct the unbalanced condition and result in marked yield increases of crops. On the other hand, the nutrient balance may be further upset if the wrong elements, ratio or rate is applied. These may be reflected by decrease in yield. If any interaction consistently occurs under a particular soil, crop or seasonal condition, then this is a factor that must be considered in the fertilizer recommendaton[1]. Any particulars field and crop has characteristics that assist in choosing a suitable fertilizer program. In the developed countries most farmers use large amounts of compound fertilizers because granulated compounds are so convenient and labour is scarce. However, a few still use straight fertilizers. Farm mixing is most satisfactory if the materials used are restricted to ammonium sulphate, super phosphate and muriate of potash, these straight fertilizers will give no trouble, except that the mixture may set if it is stored[2].

Mint (*Mentha spicata)* is a very common herb in this sub-continent and is widely used as herbal medicine[3]. The general composition of leaves of growting mint *(M. spicata)* is a follows : moisture 83%, protein 45%, ether extract fat 0.6%, carbohydrates 8.0%, fiber 2%, mineral, vitamin A, nicotinic acid 0.4%, riboflavin 80 mg and thiamin 50 mg/100g[4]. Patra *et al*[5]. carried out research on Japanese mint (*M. spicata)* and showed that 1.24 kg N, 0.33 kg P and 0.33 kg K were required to produce one liter of essential oil. The output-input ratio was highest for oil yield goal with the supply of 50 kg N, 23 kg P and 12 kg K at Pantnagar but with recommended doses of NPK (200 : 26 : 50) at Lucknow. Literature reviews showed very limited works have been done on mint. Therefore, a pot experiment was designed to evaluate the effects of NPK fertilizers on the growth and nutrient contents on medicinally important mint *(M. spicata).*

Materials and Methods

Soil sample was collected from char land of the bank of the river Buriganga (Aminpur, Dhaka) from a depth of 0-10 cm., air-dried, ground, sieved (<2 mm) and stored in polyethylene bags. The analytical data showed that the soil had a pH (1:2.5 water) of 6.8, available and total N of 1.2 mg/100g soil and 0.018% respectively[6], available and total P of 0.16 mg/kg soil and 0.014% respectively[7], exchangeable and total K of 29 mg/kg soil and 0.28%, respectively[8], organic carbon of 0.34% and cation exchange capacity of 8.08 meq/100g soil[9] and the textural class was found as sand[10].

Eight kilogram of soil was taken per earthen pot (26 x 15 cm). Three rates of each of nitrogen as urea (20, 40 and 80 kg/ha), phosphorus as triple super phosphate (10,

20 and 40 kg/ha) and potassium as muriate of potash (30, 60 and 120 kg/ha) were applied in such a way that each treatment contains a combination of three fertilizers. Twenty-seven combinations of NPK fertilizers were prepared as per treatment structure. The fertilizers were taken into solution by adding distill water and was mixed up in the soil properly. The pots were arranged in a completely randomized block design in a net house with three replictions together with a control. Each pot received three healthy stem of mint (*M. spicata*) of equal size. Water was added to bring the soil under suitable potting consistency. After 60 days of transplanting, the plants (lef, stem and root) were harvested separately and height of stem, fresh and dry weights of leaf, stem and root were recorded. Plant samples were digested[11] and total N, P and K contents were determined by atomic absorption spectrophotometer. LSD (at 5% level) was calculated to compare the treatment effects on the growth and nutrient contents of mint.

Results and Discussions

Growth of mint : The results showed an over all significant (P=0.05) increase of height at all the levels of N, P and K over the control (Table 1). The tallest mint plant (30.50 cm) was found in pot treated with $N_{80}P_{40}K_{60}$ combination followed by 29.0 cm under $N_{80}P_{20}K_{60}$ treatment. The appliction of mixed fertilizer bearing N, P and K signficantly (P=0.05) increased the fresh and dry weights of mint. The maximum values of the vegetative growth (5.00, 8.57 and 8.41 g/ pot for leaf, stem and root respectively) and dry matter (0.69, 1.39 and 1.15 g/pot) of mint were recorded under the treatment $N_{80}P_{40}K_{60}$ followed by $N_{80}P_{20}K_{60}$ (Table 1). The responses have been found due to added N, P and K in sandy soil having low status of available NPK. the vegetative growth and dry matter production of mint increased with increased rate of applied NPK fertilizers in most of the cases. However, application of K about 60 kg/ha limited the vegetative growth and dry matter yield of mint. Production of stem was found to be higher than those of root and leaf in all most every combination of N, P and K fertilizers.

Nutrient uptake by mint : The combined application of N, P and K fertilizers significantly (P= 0.05) increased the uptake of N, P and K in stem, leaf and root of mint (Table 2). The application of N increased the uptake of N significanlty in stem, leaf and root of mint (Table 2). The highest uptake of N by mint has been recorded in the leaf (14.15 mg/pot) followed by stem (12.51 mg/pot) and root (11.04 mg/pot) under the treatment $N_{80}P_{40}K_{60}$ followed by $N_{80}P_{20}K_{60}$. The general trends of N uptake in mint has been observed as : leaf > stem > root irrespective of the treatment combinations.

Phosphorus uptake by mint has been found to be irregular. The highest values of P uptake were 1.38, 0.70 and 0.81 mg/pot for leaf, stem and root, respectively. Plants treated with $N_{80}P_{40}K_{60}$ accumulated the highest amount of P in different vegetative parts of the mint plant. This was followed by $N_{80}P_{20}K_{60}$ treatment. Comparatively the higher uptake of P in the leaf of mint might be reflected by higher protein synthesis than stem and root. Leafy portion of the plant generally accumulated highest amount of phosphorus among the vegetative parts. The highest accumulation of potassium (60.05 mg/pot) has been found in the stem. This was followed by root (41.40 mg/pot) and leaves (31.95 mg/pot) under the treatment of $N_{80}P_{40}K_{60}$ combination. Potassium uptake in mint followed a general trend of the highest as : stem > root > leaf at all most all the combination of NPK fertilizers.

Mint *(M. spicata)* showed a significant response to applied NPK fertilizers in sandy soil of char land of river bank. A combination of $N_{80}P_{40}K_{60}$ resulted in the best performance on quantitative and qualitative improvement of *Mentha spicata*. Growth and nutrient uptake (NPK) by mint was significantly increased to applied NPK fertilizers having a ratio of 2 : 1 : 1.5.

Table 1. Effect of NPK fertilizers on growth and dry matter production of mint *(Mentha spicata)*.

Treatment	Height	Vegetative weight			Dry weight					
	(75 days)	Leaf	Stem	Root	Leaf		Stem		Root	
	(cm)	(gm/pot)	(gm/pot)	(gm/pot)	(gm/pot)	IOC* (%)	(gm/pot)	IOC* (%)	(gm/pot)	IOC* (%)
Control	9.5	0.81	0.88	0.91	0.09	0	0.13	0	0.12	0
$N_{20}P_{10}K_{30}$	19.0	2.44	2.80	2.53	0.32	256	0.51	292	0.36	200
$N_{20}P_{20}K_{30}$	19.0	2.85	3.08	3.20	0.35	289	0.48	269	0.38	217
$N_{20}P_{40}K_{30}$	22.0	3.36	3.36	4.17	0.32	256	0.47	262	0.48	300
$N_{20}P_{10}K_{60}$	18.0	2.66	2.79	3.57	0.30	233	0.51	292	0.48	300
$N_{20}P_{20}K_{60}$	19.0	3.16	4.46	3.34	0.32	256	0.61	369	0.45	275
$N_{20}P_{40}K_{60}$	20.0	3.62	4.3	64.12	0.32	256	0.59	354	0.52	333
$N_{20}P_{10}K_{120}$	16.0	3.06	3.45	3.83	0.24	167	0.54	315	0.45	275
$N_{20}P_{20}K_{120}$	20.5	2.37	3.85	2.86	0.29	222	0.55	323	0.39	225
$N_{20}P_{40}K_{120}$	23.0	3.00	4.31	3.55	0.31	244	0.50	285	0.48	300
$N_{40}P_{10}K_{30}$	19.5	2.77	3.95	3.49	0.35	289	0.51	292	0.52	333
$N_{40}P_{20}K_{30}$	20.0	2.98	3.81	3.52	0.35	289	0.56	331	0.62	417
$N_{40}P_{40}K_{30}$	19.5	3.46	4.03	3.98	0.39	333	0.59	354	0.68	467
$N_{40}P_{10}K_{60}$	16.0	2.87	3.99	4.26	0.34	278	0.54	315	0.50	317
$N_{40}P_{20}K_{60}$	22.5	3.03	4.23	4.22	0.32	256	0.39	200	0.45	275
$N_{40}P_{40}K_{60}$	21.0	3.09	4.82	4.18	0.37	311	0.58	346	0.53	342
$N_{40}P_{10}K_{120}$	23.0	3.10	4.70	4.00	0.30	233	0.46	254	0.41	242
$N_{40}P_{20}K_{120}$	23.5	3.56	4.85	4.65	0.32	256	0.75	477	0.73	508
$N_{40}P_{40}K_{120}$	22.0	3.04	4.82	4.70	0.45	400	0.69	431	0.66	450
$N_{80}P_{10}K_{30}$	22.5	3.61	4.05	4.02	0.49	444	0.49	277	0.50	317
$N_{80}P_{20}K_{30}$	26.0	4.03	7.22	5.96	0.53	489	0.93	615	0.98	717
$N_{80}P_{40}K_{30}$	28.0	4.63	7.33	6.08	0.54	500	1.10	746	0.94	683
$N_{80}P_{10}K_{60}$	26.0	3.84	6.13	5.89	0.44	389	0.98	654	1.09	808
$N_{80}P_{20}K_{60}$	29.0	4.65	7.83	8.03	0.55	511	1.18	808	1.02	750
$N_{80}P_{40}K_{60}$	30.5	5.00	8.57	8.41	0.69	667	1.39	969	1.15	858
$N_{80}P_{10}K_{120}$	20.0	4.37	6.02	4.07	0.39	333	0.75	477	0.51	325
$N_{80}P_{20}K_{120}$	28.0	3.86	4.41	5.89	0.43	378	0.57	338	0.55	358
$N_{80}P_{40}K_{120}$	27.5	3.70	4.36	4.13	0.41	356	0.68	423	0.55	358
LSD at 5% level	**1.4**	**0.22**	**0.88**	**0.10**	**0.16**		**0.09**		**0.40**	

* Increase over control.

Table 2. Effect of NPK fertilizers on N, P and K uptakes by mint *(Mentha spicata)*.

Treatment	Uptake (mg/pot)								
	N			P			K		
	Leaf	Stem	Root	Leaf	Stem	Root	Leaf	Stem	Root
Control	1.79	1.01	1.01	0.07	0.08	0.07	03.71	05.49	4.69
$N_{20}P_{10}K_{30}$	5.02	4.44	3.24	0.29	0.26	0.14	14.18	19.94	14.08
$N_{20}P_{20}K_{30}$	6.34	3.89	3.31	0.28	0.27	0.19	14.77	19.78	10.94
$N_{20}P_{40}K_{30}$	6.37	3.67	4.03	0.38	0.20	0.24	11.87	19.83	20.26
$N_{20}P_{10}K_{60}$	7.14	6.12	4.32	0.30	0.29	0.38	14.22	21.01	20.02
$N_{20}P_{20}K_{60}$	5.22	5.86	3.78	0.42	0.34	0.27	13.50	26.35	17.82
$N_{20}P_{40}K_{60}$	8.10	5.49	4.68	0.29	0.33	0.31	13.82	26.14	20.85
$N_{20}P_{10}K_{120}$	7.08	5.35	3.78	0.22	0.30	0.41	10.87	22.79	19.94
$N_{20}P_{20}K_{120}$	5.25	6.27	3.74	0.38	0.42	0.27	11.66	20.96	12.05
$N_{20}P_{40}K_{120}$	3.16	4.50	4.03	0.28	0.28	0.29	10.54	22.15	18.29
$N_{40}P_{10}K_{30}$	9.70	6.12	4.68	0.39	0.31	0.42	17.29	19.94	18.20
$N_{40}P_{20}K_{30}$	8.86	5.38	4.84	0.35	0.34	0.31	18.03	22.51	23.31
$N_{40}P_{40}K_{30}$	8.70	6.02	5.92	0.27	0.41	0.27	19.27	26.14	24.14
$N_{40}P_{10}K_{60}$	7.38	5.35	3.75	0.27	0.38	0.20	16.80	21.71	18.80
$N_{40}P_{20}K_{60}$	5.79	4.10	3.78	0.22	0.27	0.32	12.51	16.07	14.36
$N_{40}P_{40}K_{60}$	7.36	5.92	4.13	0.30	0.35	0.32	15.61	24.48	20.19
$N_{40}P_{10}K_{120}$	5.43	4.28	3.69	0.30	0.32	0.29	16.05	18.49	14.97
$N_{40}P_{20}K_{120}$	7.71	6.30	6.79	0.32	0.38	0.51	14.88	32.78	30.44
$N_{40}P_{40}K_{120}$	5.94	8.28	6.34	0.41	0.48	0.66	20.88	26.63	24.09
$N_{80}P_{10}K_{30}$	9.26	5.15	4.50	0.44	0.39	0.40	22.69	21.17	16.75
$N_{80}P_{20}K_{30}$	8.32	8.37	8.23	0.69	0.65	0.78	24.01	37.85	34.30
$N_{80}P_{40}K_{30}$	12.96	11.88	7.61	0.59	0.55	0.85	21.71	41.36	27.54
$N_{80}P_{10}K_{60}$	8.76	8.92	8.83	0.92	0.69	0.76	22.04	36.16	40.44
$N_{80}P_{20}K_{60}$	11.50	11.68	8.98	1.32	0.59	0.71	24.37	44.96	33.05
$N_{80}P_{40}K_{60}$	14.15	12.51	11.04	1.38	0.70	0.81	31.95	60.05	41.40
$N_{80}P_{10}K_{120}$	8.93	8.10	4.59	0.70	0.45	0.36	21.29	35.10	19.94
$N_{80}P_{20}K_{120}$	9.46	6.21	4.13	0.60	0.40	0.28	19.91	27.87	18.70
$N_{80}P_{40}K_{120}$	9.43	8.16	4.29	0.78	0.54	0.33	17.30	31.48	20.85
LSD at 5% level	**0.19**	**0.16**	**0.21**	**0.18**	**0.09**	**0.12**	**0.38**	**0.28**	**0.22**

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